PESTICIDE SENSITIVITIES

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INTRODUCTION

Almost all pesticides are toxic and pose some health risks to everyone. There are, however, a growing number of people who react adversely to pesticides at levels far below those that cause symptoms in the average person. For these pesticide-sensitive people, exposures to even minute amounts of insecticides, herbicides, and other pesticides can trigger severe symptoms and prolonged ill health. Some are so sensitive to pesticides that they can not tolerate the pesticide residues on conventionally grown food and must eat only organic food. Many people report that they developed pesticide and other chemical sensitivities after a pesticide exposure, such as having their home or office sprayed with pesticides, being exposed to aerial drift of pesticides, or through an occupational exposure. Some farmers, ranchers, and pest control operators have developed pesticide sensitivities as a result of their work-related pesticide exposures. Reports from around the world indicate that pesticide and chemical sensitivities are a global problem.

HOW PREVALENT ARE PESTICIDE SENSITIVITIES?

Two random population-based surveys conducted by the California Department of Health Services (1) and New Mexico Department of Health (2) found that 16% of the respondents reported being unusually sensitive to common chemicals such as pesticides. In both studies, women were twice as likely as men to report being chemically sensitive. Otherwise, chemically sensitive respondents were evenly distributed among age groups, educational and income levels, and geographic locations. The percentage of respondents reporting chemical sensitivity were also similar in ethnic and racial groups except for Native Americans, who reported a higher prevalence.

Many people who are sensitive to pesticides also have adverse reactions to other common chemicals, such as those found in perfumes, tobacco smoke, new carpets, air "fresheners," fresh ink, new paint and building materials, gasoline, vehicle exhaust, and many cleaning and laundry products. However, exposures to pesticides typically induce their worst reactions. Some people are only mildly affected while others have a more severe form of the illness called multiple chemical sensitivities (MCS). In the New Mexico study (2), 2% of the respondents reported they had been diagnosed with MCS. In California (1), 3.5% of the respondents reported that they had been diagnosed with MCS and were chemically sensitive.

WHAT CAUSES PESTICIDE/CHEMICAL SENSITIVITIES AND MCS?

Many people develop pesticide and chemical sensitivities after moving into a new home, working in a recently remodeled office, spending time in a sick building, or after being exposed to pesticides or solvents. Others slowly become ill over a period of years, seemingly as the result of the cumulative exposures of everyday life. In a survey of 6800 chemically sensitive people (3), 80% stated they knew "when, where, with what, and how they were made ill." Of this group, 60% blamed pesticides for causing their illness.

Exposure to organophosphate pesticides is most implicated in triggering pesticide/chemical sensitivities and MCS. The 1997 EPA Review of Chlorpyrifos Poisoning Data (4) stated that MCS was the most commonly reported long-term health effect of chlorpyrifos poisoning. Though rarely acknowledged by pesticide manufacturers, at least one label for a chlorpyrifos-containing pesticide product warns that "repeated exposure to cholinesterase inhibitors may without warning cause prolonged susceptibility to very small doses of any cholnesterase inhibitor" (5). In addition, Miller and Mitzel (6) found that individuals who developed chemical sensitivities after a cholinesterase-inhibiting pesticide exposure (e.g., exposure to an organophosphate or carbamate pesticide) were found to have

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significantly greater symptom severity than those who developed sensitivities following exposures to building remodeling chemicals.

Farmers and ranchers are known to develop pesticide and chemical sensitivities. Sheep dippers in the United Kingdom exposed to organophosphate insecticides have reported MCS-like illnesses (7). Tabershaw and Cooper studied 114 agricultural workers who experienced acute organophosphate poisoning, some of whom developed persistent MCS-like symptoms. Three years after their acute exposure, 22 workers (19%) reported that even a "whiff" of pesticide made them feel ill (8).

Besides those who work with pesticides, individuals who are less able to detoxify pesticides are at increased risk of pesticide injury, including the development of pesticide sensitivities. This group includes young children, the elderly, and those with acquired or genetic deficiencies in detoxifying enzymes. For example, a number of organophosphate insecticides are detoxified by serum paraoxonases (PON1). There is wide variation in subtypes and levels of these enzymes in the population due to genetic polymorphisms (9). Regardless of genetic make-up, all newborns have very low levels of PON1. These and other enzyme differences contribute to a very wide variation in individual susceptibility to organophosphate poisoning.

Haley et al. (10) found an association between low levels of a type of serum paraoxonase and neurologic symptoms in Gulf War Veterans. Veterans who served in the Gulf War were exposed to numerous cholinesterase-inhibiting substances including insecticides and antinerve gas pills (pyridostigmine bromide). These results suggest that certain soldiers may have had an impaired ability to metabolize cholinesterase-inhibiting chemicals that led to their increased susceptibility to becoming ill. Of note is that many ill Gulf War veterans also report being chemically sensitive. Kipen et al. (11) found that 36% of ill veterans on the Gulf War Registry reported having developed chemical sensitivities.

WHAT ARE THE SYMPTOMS OF PESTICIDE SENSITIVITIES?

Chemically sensitive people react to a wide variety of pesticides, including insecticides (organophosphates, pyrethroids, and carbamates), herbicides, fungicides, and fumigants. Exposures may occur via inhalation, ingestion, or skin contact. Exposures to even minute amounts of pesticides from, for example, pesticide drift or volatization from neighborhood lawn treatments, driving on a street whose roadside has been sprayed with herbicides, being in a house that was treated with pesticides years earlier, or eating food with pesticide residues can cause serious health problems for someone who is pesticide sensitive. Symptoms can range from mild to life-threatening and include, but are not limited to, headache, trouble concentrating, nausea and vomiting, fatigue, dizziness, tremulousness, rashes, asthma, irregular heartbeat, and joint and muscle pain. Neurologic and gastrointestinal symptoms often predominate following pesticide exposures.

Case example 1 A 35-year-old woman with pesticide sensitivities felt ill after a glyphosate-containing herbicide being used in a neighbor's yard wafted through her open window. She became progressively more nauseated over the next few days and began vomiting.By the fifth day after the exposure, she began to vomit blood and was admitted to the

1) **The symptoms are reproducible with repeated chemical exposure.**

2) **The condition is chronic.**

3) **Low levels of exposure (lower than previously or commonly tolerated) result in manifestations of the syndrome.**

4) **The symptoms improve or resolve when the incitants are removed.**

5) **Responses occur to multiple chemically unrelated substances.**

6) **Symptoms involve multiple organ systems.**

Fig. 1 Concensus criteria for diagnosing multiple chemical sensitivities (MCS).

hospital with gastrointestinal bleeding. Endoscopy revealed erosive lesions in her esophagus.

Case example 2 A 42-year-old woman with severe pesticide sensitivities took a bite of steamed zucchini that she had been told had been organically grown. She immediately developed nausea, abdominal pain, dizziness, irregular heartbeat, and numbness and tingling on her face.When she called the store where the zucchini had been purchased, she was told that the zucchini was NOT certified organic.

Physicians diagnose pesticide and chemical sensitivities by taking a history, performing a physical exam, and determining whether a person's symptoms come and go in relation to chemical exposures. Though not diagnostic in themselves, chemically sensitive people often have a variety of abnormal laboratory tests such as single photon emission computed tomography (SPECT) brains scans (12), electroencephalograms (following chemical challenge) (13), immune studies (14), tests of porphyrin metabolism (15), and neuropsychological evaluations. Consensus criteria for diagnosing MCS were published in 1999 (15) (see Fig. 1).

WHAT IS THE MECHANISM OF PESTICIDE AND CHEMICAL SENSITIVITIES?

A small percentage of pesticide-sensitive people may have traditional IgE (immediate) or IgG (delayed hypersensitivity) allergic reactions, such as immune-mediated rashes or asthma. Others have typical toxic reactions to pesticides, but at doses far below the norm. The mechanism for the sensitivities in the vast majority of pesticide-sensitive people, whose symptoms may vary from person to person, has not been well elucidated.The leading view, however, is that chemical sensitivities result primarily from a neurotoxic injury. Besides evidence of neurologic dysfunction, most people who are sensitive to pesticides and chemicals also have evidence of endocrine, detoxification, and immune system abnormalities.

WHAT IS THE IMPACT OF PESTICIDE AND CHEMICAL SENSITIVITIES?

According to Ashford and Miller (16), "existing evidence does suggest that chemical sensitivity is on the rise and could become a large problem with significant economic consequences related to the disablement of productive members of society." The impact on people who develop pesticide and chemical sensitivities can be enormous. It is not uncommon for people to lose their jobs, careers, homes, savings, friends, and families, besides losing their health. People are often too sick to work and cannot tolerate most workplaces and homes. Their illness can also be confusing and overwhelming to friends and family members who may distance themselves rather than offer support.

The cost to society is also high when one considers the lost productivity of skilled professionals and employees and the cost of supporting disabled workers. Chemical sensitivities is considered a potentially disabling condition by the U.S. Social Security Administration (17) and U.S. Department of Housing and Urban Development (HUD) (18), and is covered under the Americans with Disabilities Act on a case-by-case basis (19). Workers in some states have also been awarded workers' compensation benefits.

In summary, pesticide and chemical sensitivity is a large and growing public health problem that warrants greater attention by the private and public sectors. The agricultural community, in particular, would benefit from a better understanding of the risks to agricultural workers of developing pesticide and chemical sensitivities, the need to notify pesticide-sensitive people of anticipated pesticide applications, and the influence of people who are intolerant of conventionally grown food on the increasing sales of organic food.

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